Handle System Overview

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Corporation for National Research Initiatives
http://www.cnri.reston.va.us/
http://www.handle.net/

Digital Object Architecture - Goals

- Framework for managing Digital (Information) Objects
- Give it a name and talk to it
  - Don’t worry about where it is
  - Don’t worry about what it’s made of
- Rise above details of application versions and content formats

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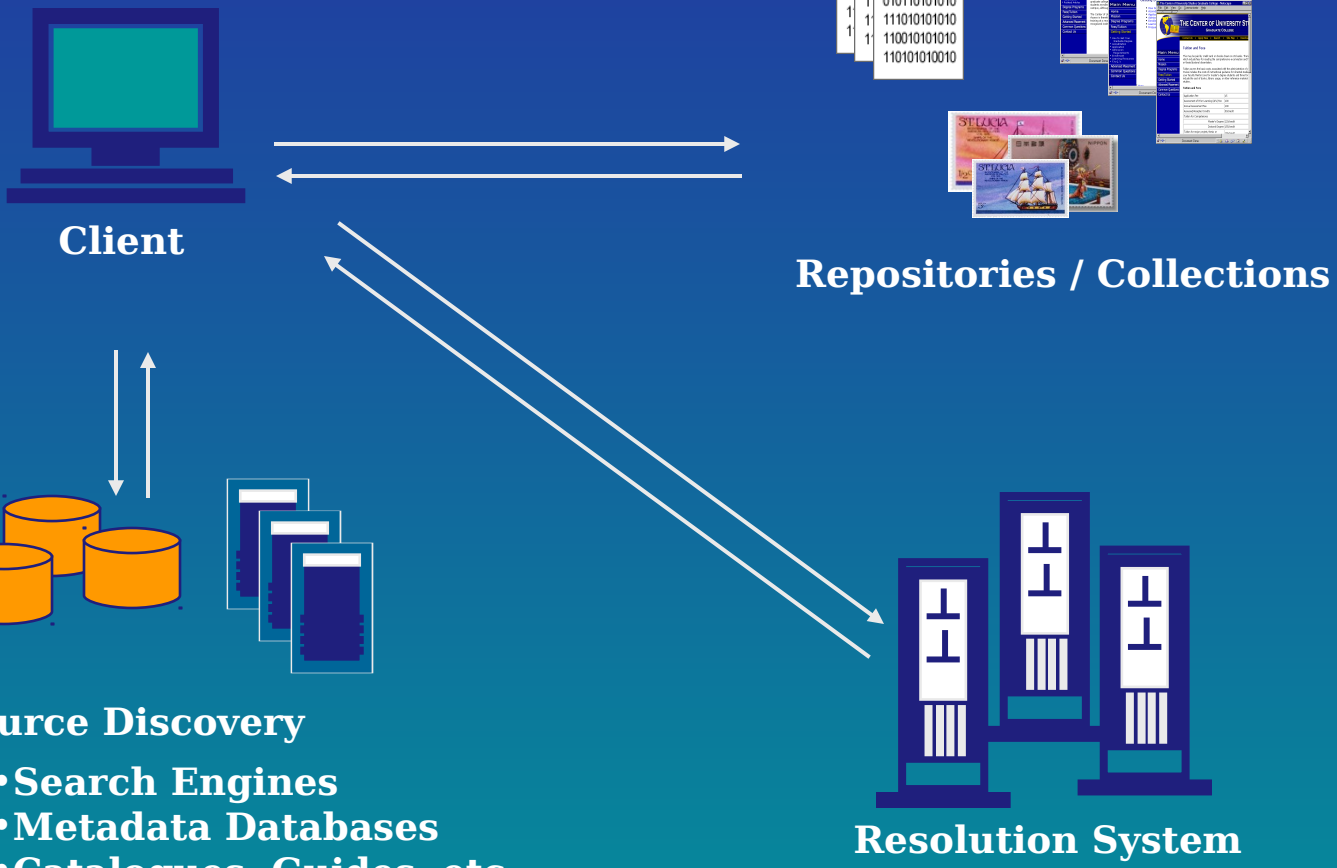
Digital Object Architecture



Digital Object Architecture Components Handle System

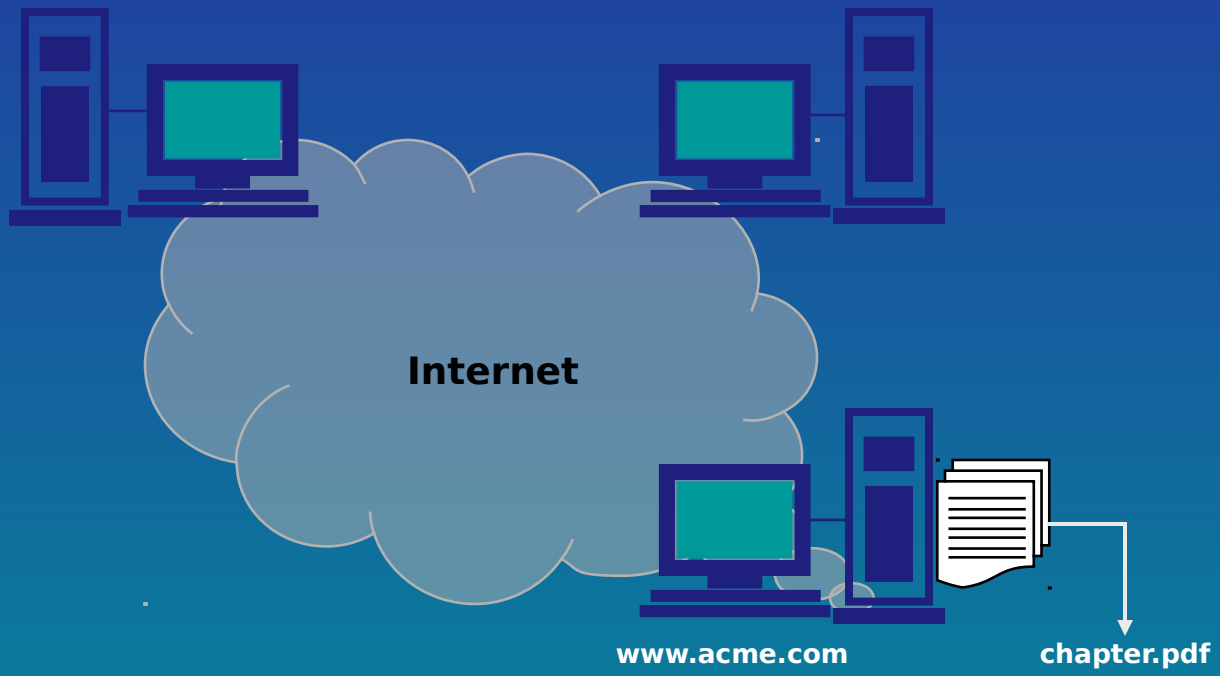
- Go from name to attributes
- Fundamental indirection system for Digital Object management on the net
- No free lunch
  - Added layer of infrastructure
  - Must be managed

Digital Object Architecture Components Repository

- Frees digital content from constraints of specific technologies
- Provide access across systems, space, time
- No free lunch
  - Added layer of infrastructure
  - Must be managed

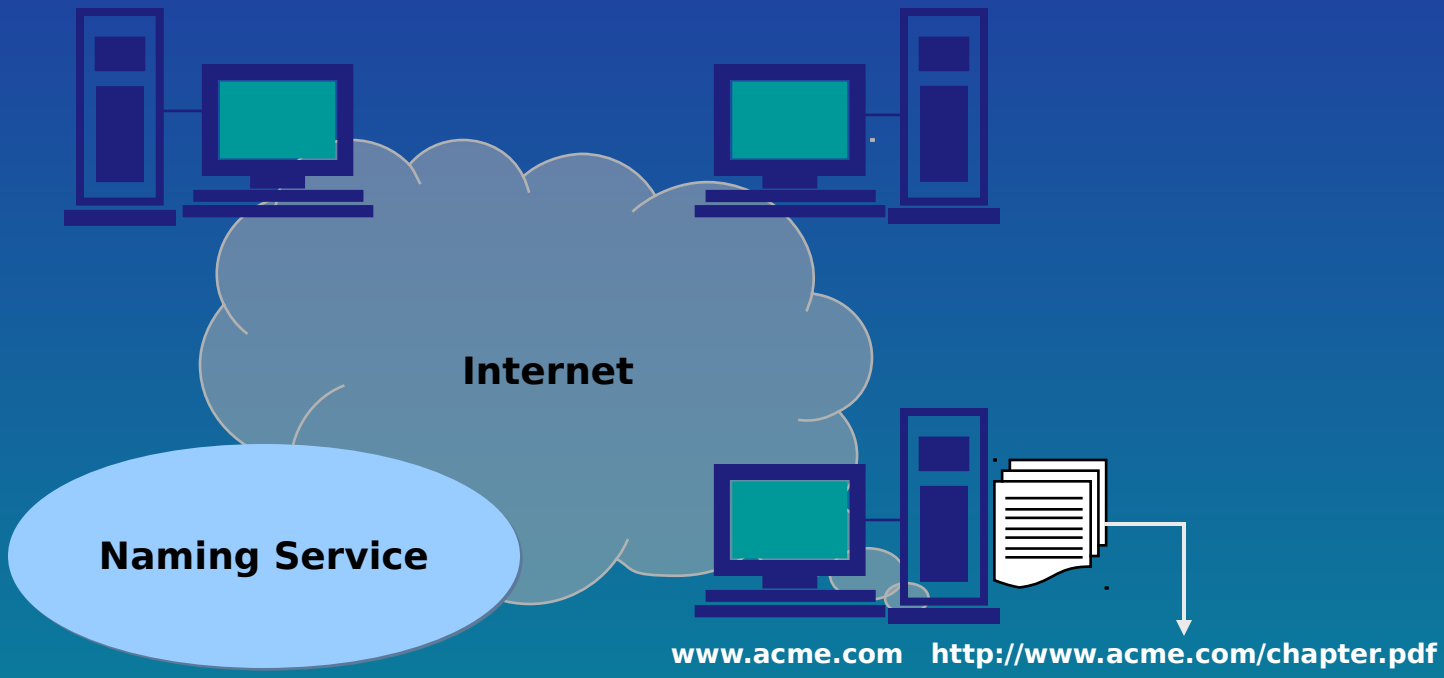
Naming Resources on the Net

The Problem



Naming Resources on the Net

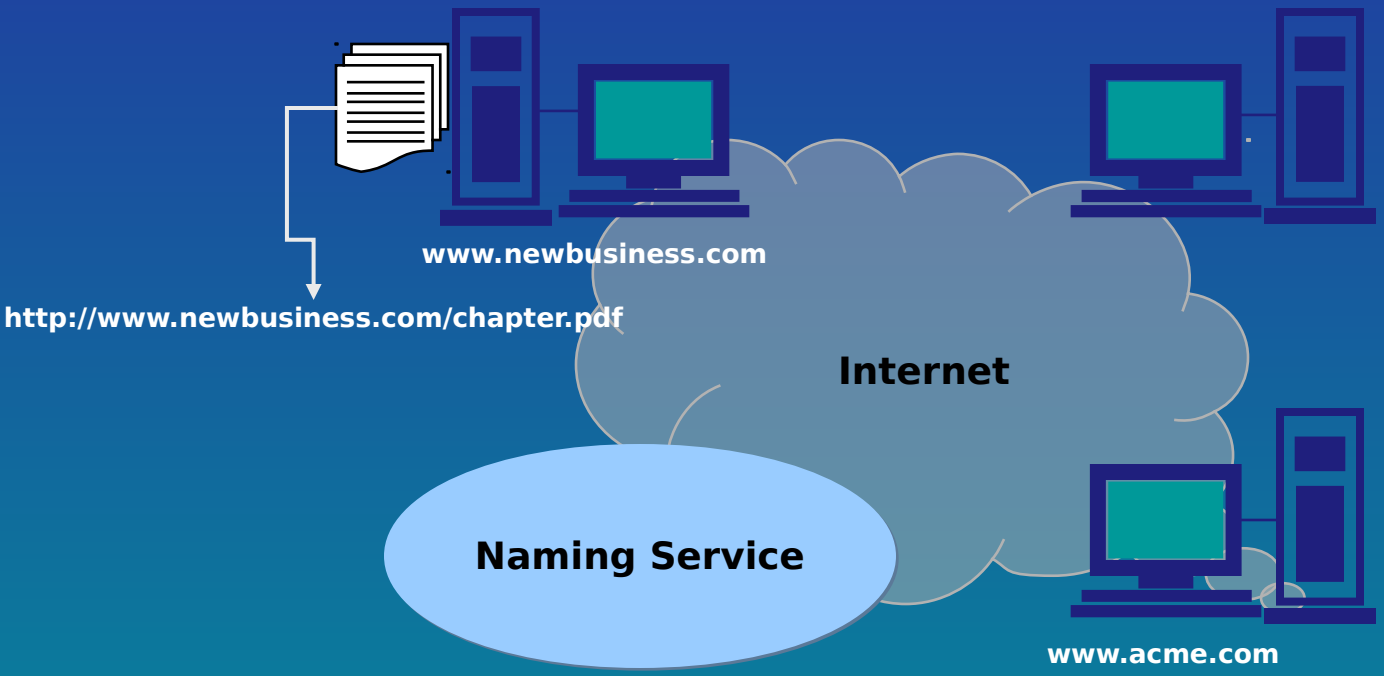
The Solution



Name = Value(s)
10.123/xyz = http://www.acme.com/chapter.pdf

Naming Resources on the Net

The Solution



Name = Value(s)
10.123/xyz = http://www.newbusiness.com/chapter.pdf

CNRI Handle System

- Distributed, scalable, secure
- Enforces unique names
- Enables association of one or more typed values, e.g., URL, with each name
- Optimized for speed and reliability
- Open, well-defined protocol and data model
- Provides infrastructure for application domains, e.g., digital libraries, electronic publishing ...

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Handle System Implementations

- IDF (International DOI Foundation)
  - CrossRef (scholarly journal consortium)
  - Enpia (Korean content management technology firm)
  - CDI (U.S. content management technology firm)
  - LON (U.S. learning object technology firm)
  - CAL (Copyright Agency Ltd - Australia)
  - TSO (U.K. publisher & info mgmt service provider)
  - MEDRA (Multilingual European DOI Registration Agency)
- Library of Congress
- DSpace (MIT Libraries & HP)
- cIDF (Content IDF Forum, based in Japan)
- DTIC (Defense Technical Information Center)
- NTIS (National Technical Information Service)
- Various digital library production and research projects

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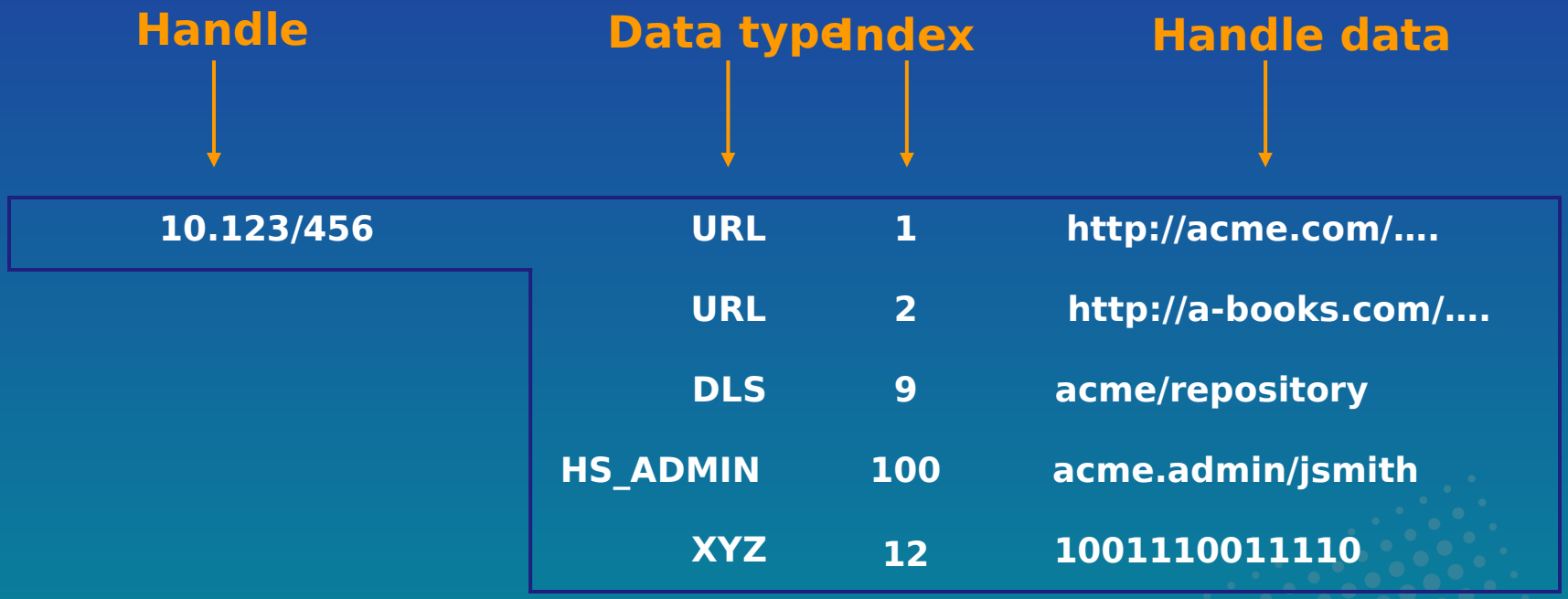
Handles Resolve to Typed Data



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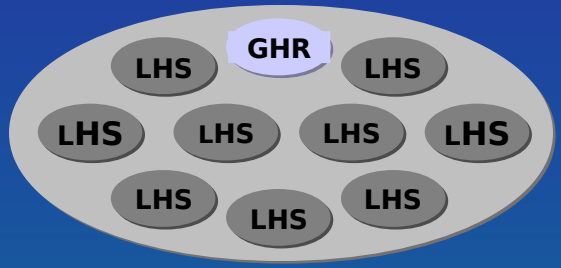
The Two Types of Handle Query

1. Request all data

Give me all data associated with handle 10.1000/123.

Handle	Index	Type	Data
10.1000/123	3	URL	URL1(Server in US)
	2	URL	URL2 (Server in Asia)
	5	URL	URL3 (Server in Europe)
	10	PK	public key
	9	EM	email address
	4	IP	rights data

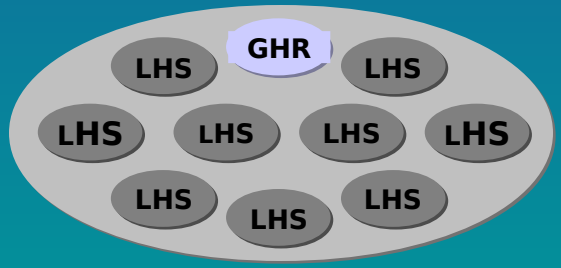


Handle System

2. Request all data of a given type

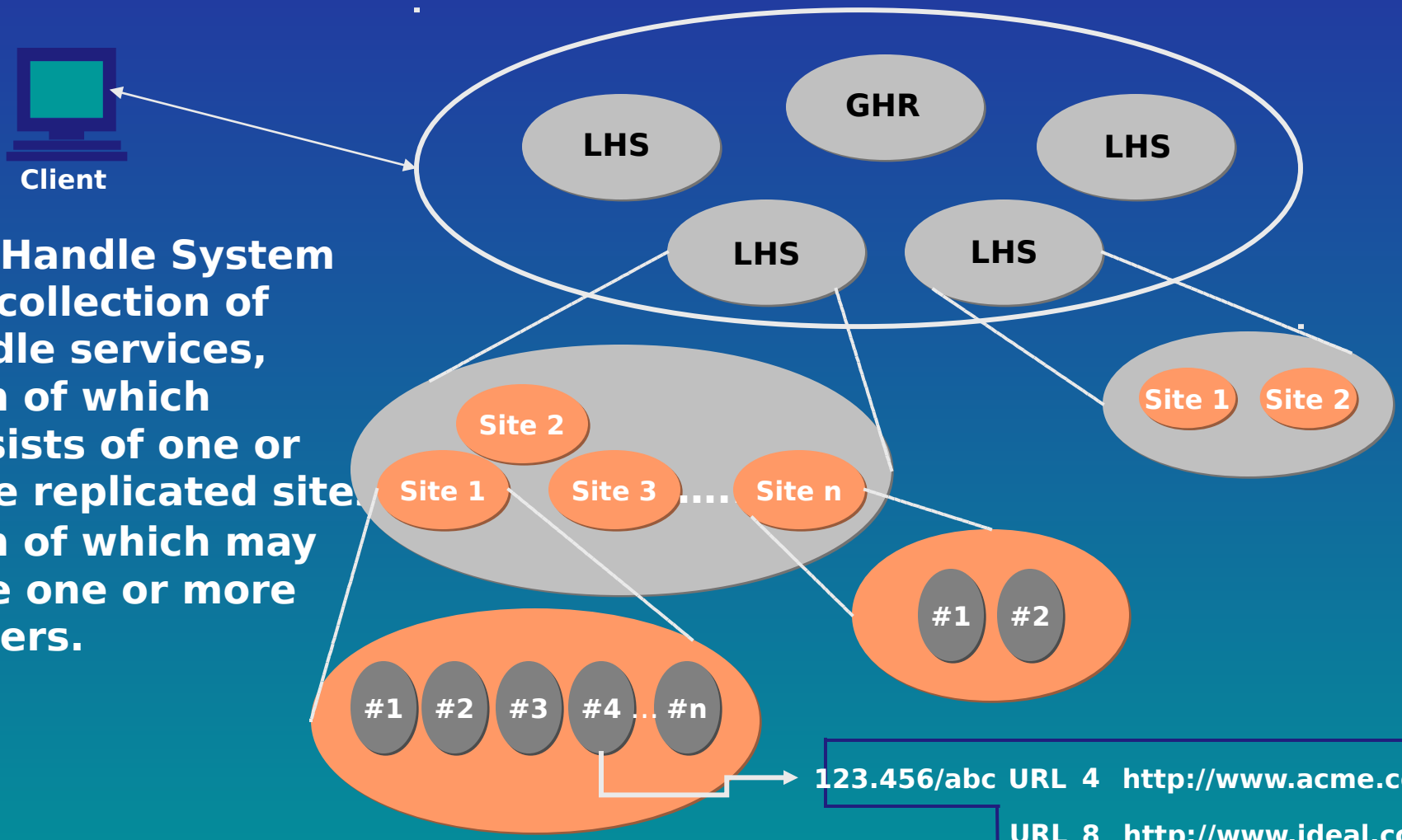
Give me all data of type URL associated with handle 10.1000/123.

Handle	Index	Type	Data
10.1000/123	3	URL	URL1(Server in US)
	2	URL	URL2 (Server in Asia)
	5	URL	URL3 (Server in Europe)



Handle System

Handle Resolution



The Handle System is a collection of handle services, each of which consists of one or more replicated sites, each of which may have one or more servers.

Handle Clients

Request to Client:
Resolve hdl:10.1000/1

Client

1. Sends request to Global to resolve 0.NA/10.1000 (naming authority handle for 10.1000)

Global Handle Registry

Handle Clients

Request to Client:
Resolve hdl:10.1000/1

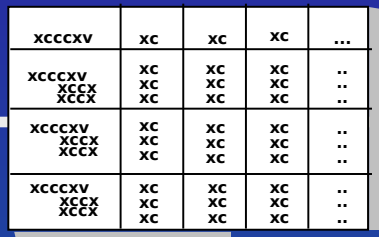
Client

2. Global Responds with
Service Information for 10.1000

Global Handle Registry

xccccxv	xc	xc	xc	...
xccccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..
xccccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..
xccccxv xccx xccx	xc xc xc	xc xc xc	xc xc xc	.. .. ..

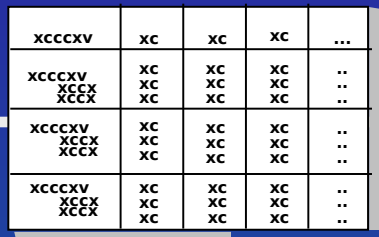
Service Information
Acme Local Handle Service



Handle Clients

	IP Address	Port #	Public Key	...
Primary Site				
Server 1	**123.45.67.8**	**2641**	**K03RLQ...**	**...**
Server 2	**123.52.67.9**	**2641**	**5&M#FG...**	**...**
Secondary Site A				
Server 1	**321.54.678.12**	**2641**	**F^*JLS...**	**...**
Server 2	**321.54.678.14**	**2641**	**3E$T%...**	**...**
Server 3	**762.34.1.1**	**2641**	**A2S4D...**	**...**
Secondary Site B				
Server 1	**123.45.67.4**	**2641**	**N0L8H7...**	**...**

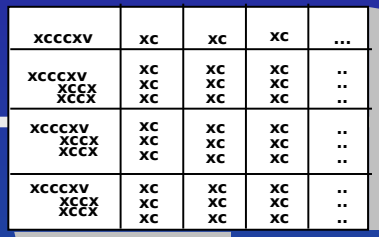
Service Information - Acme Local Handle Service


xcccxv xc xc xc ...
xcccxv xccx xccx xc xc xc xc xc xc xc xc xc xc .. .. ..
xcccxv xccx xccx xc xc xc xc xc xc xc xc xc xc .. .. ..
xcccxv xccx xccx xc xc xc xc xc xc xc xc xc xc .. .. ..

Handle Clients

	IP Address	Port #	Public Key	...
Primary Site				
Server 1	**123.45.67.8**	**2641**	**K03RLQ...**	**...**
Server 2	**123.52.67.9**	**2641**	**5&M#FG...**	**...**
Secondary Site A				
Server 1	**321.54.678.12**	**2641**	**F^*JLS...**	**...**
Server 2	**321.54.678.14**	**2641**	**3E$T%...**	**...**
Server 3	**762.34.1.1**	**2641**	**A2S4D...**	**...**
Secondary Site B				
Server 1	**123.45.67.4**	**2641**	**N0L8H7...**	**...**

Service Information - Acme Local Handle Service



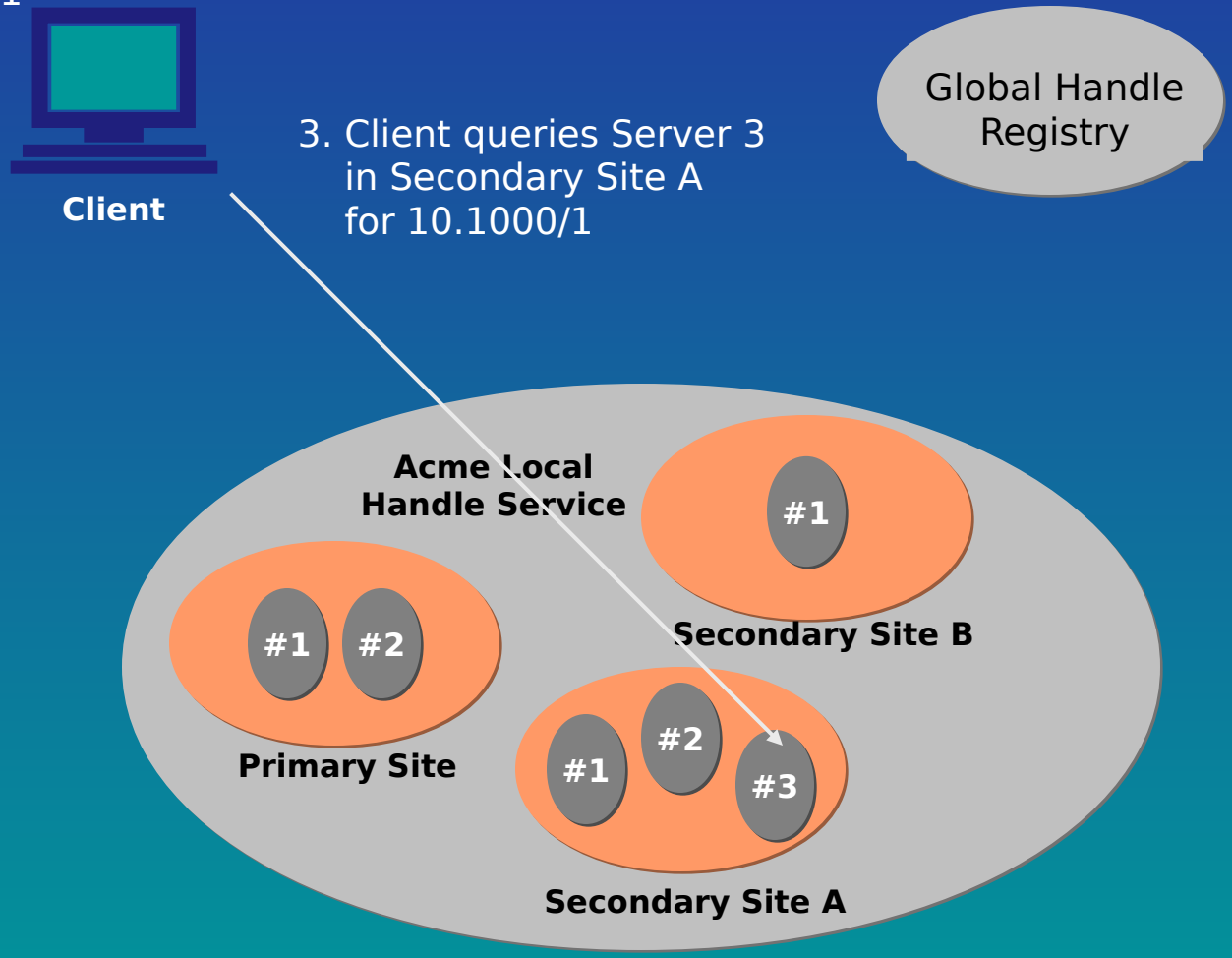
Handle Clients

	IP Address	Port #	Public Key	...
Primary Site				
Server 1	123.45.67.8	2641	K03RLQ...	...
Server 2	123.52.67.9	2641	5&M#FG...	...
Secondary Site A				
Server 1	321.54.678.12	2641	F^*JLS...	...
Server 2	321.54.678.14	2641	3E$T%...	...
Server 3	762.34.1.1	2641	A2S4D...	...
Secondary Site B				
Server 1	123.45.67.4	2641	N0L8H7...	...

Service Information - Acme Local Handle Service

Handle Clients

Request to Client:
Resolve hdl:10.1000/1



Handle Clients

Request to Client:
Resolve hdl:10.1000/1

Client

Global Handle Registry

4. Server responds with handle data

Acme Local Handle Service

#1 **#2**

Primary Site

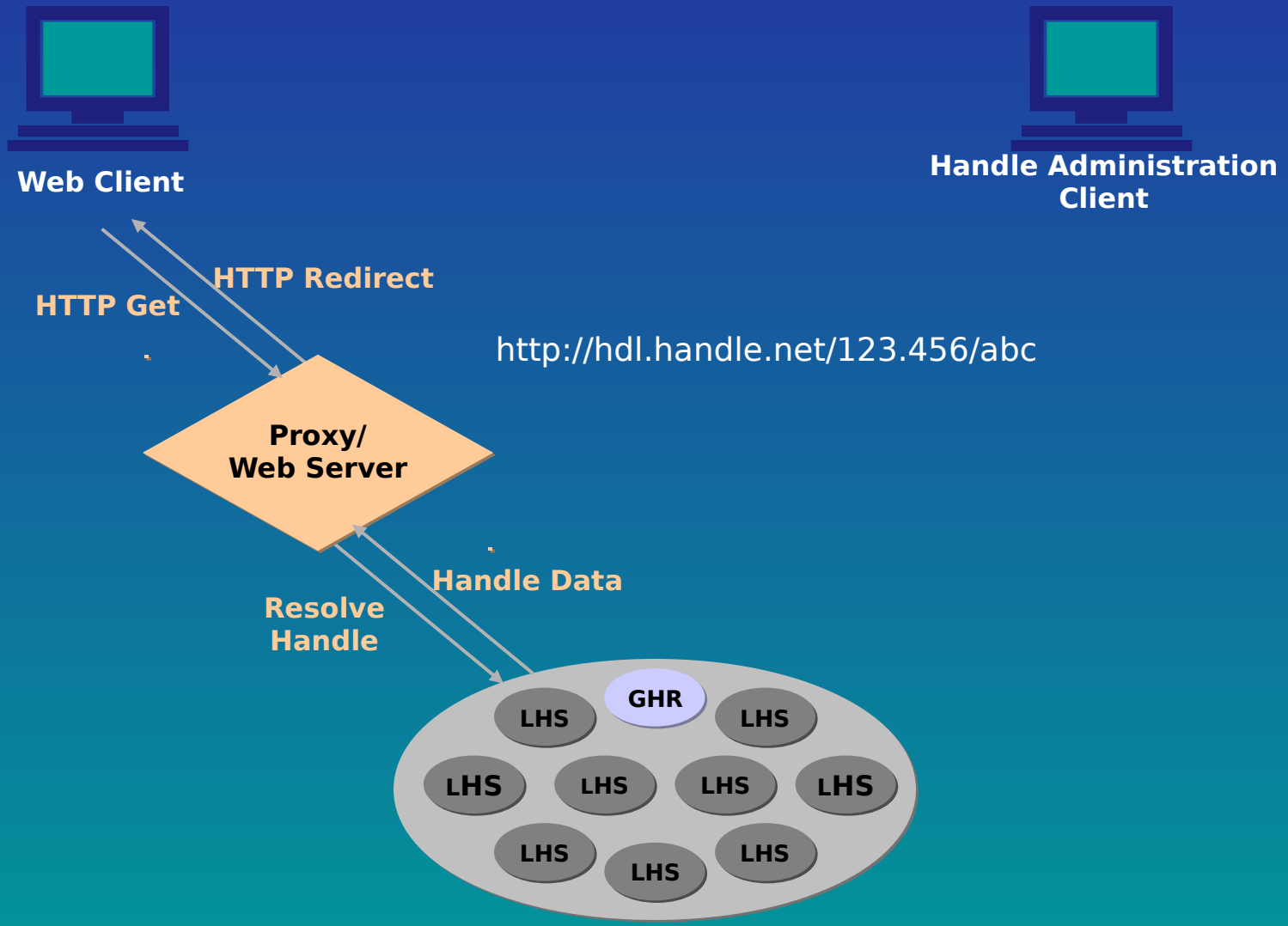
#1

Secondary Site B

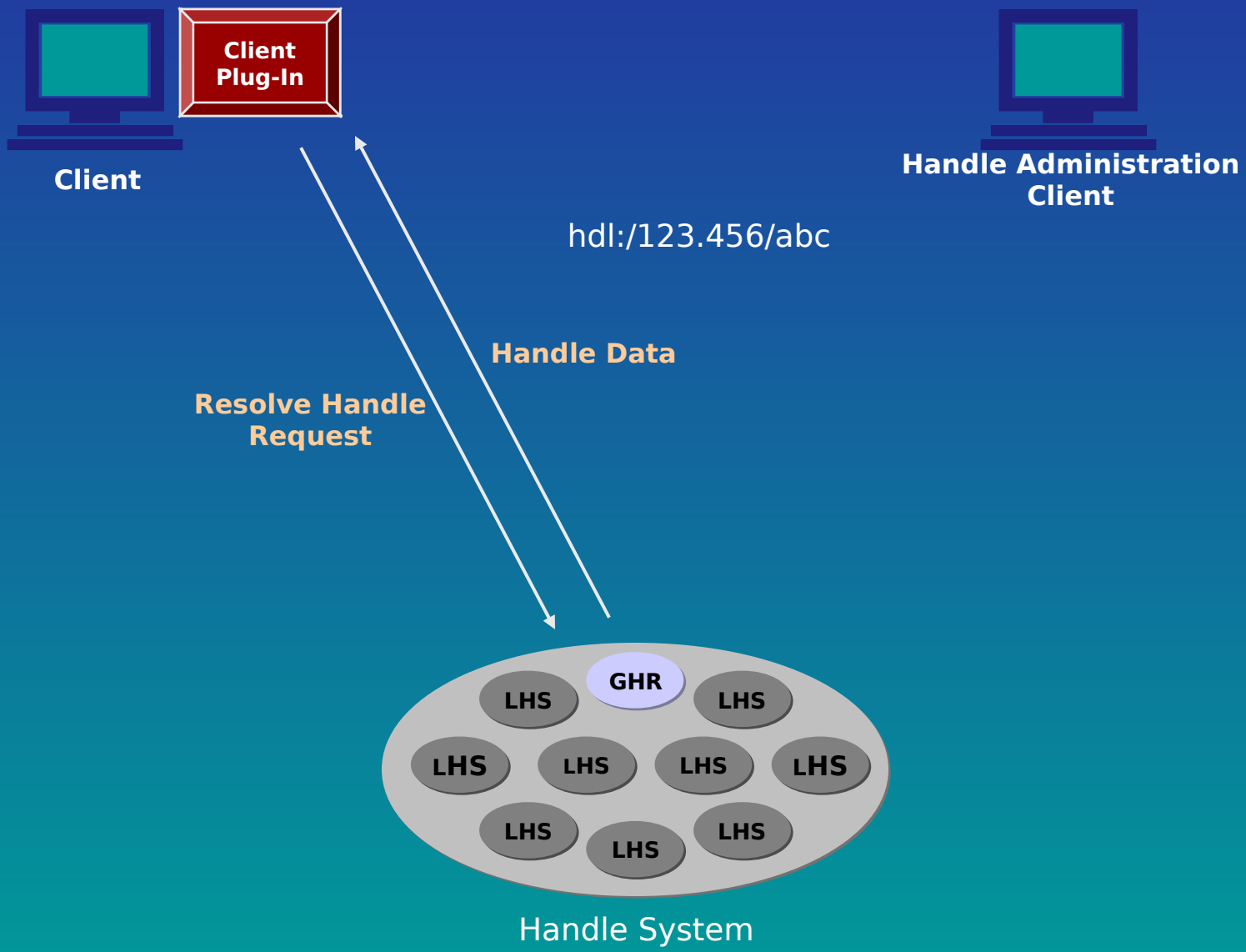
#1 **#2** **#3**

Secondary Site A

Handle Clients



Handle Clients

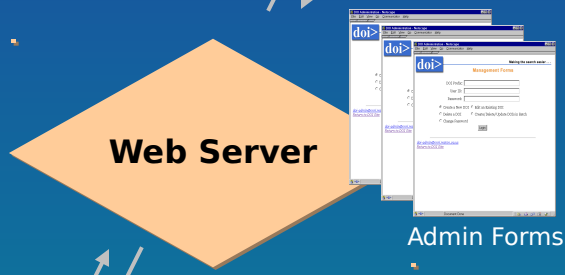


Handle Clients

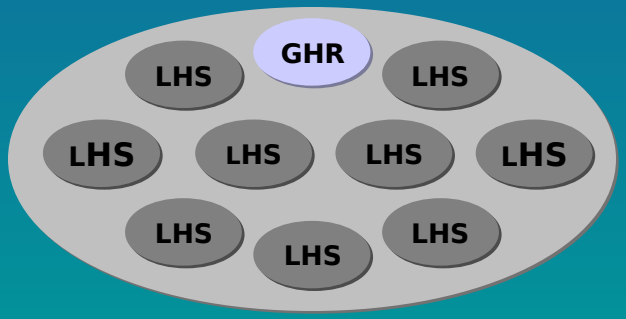
Web

Handle Administration Client

HTTP

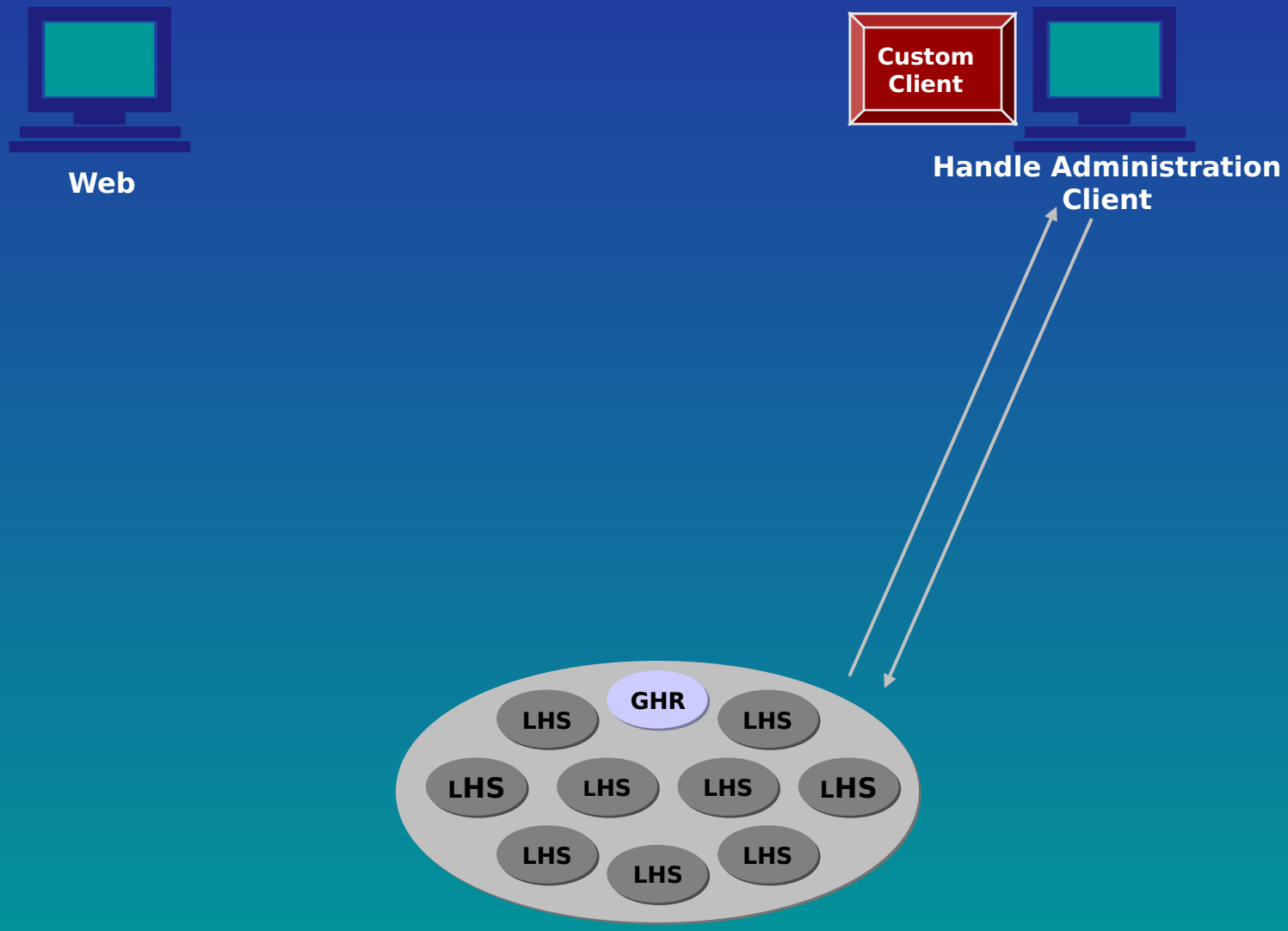


Handle Admin API



Handle System

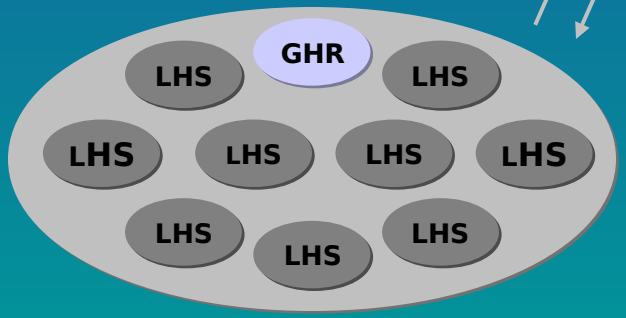
Handle Clients



Handle Clients

Web

Handle Administration embedded in another process

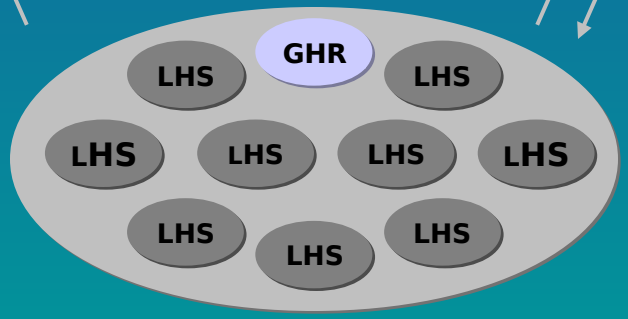


Handle System

Handle Clients

Handle Resolution embedded in another process

Handle Administration embedded in another process



Handle System

HS Administration

- Ownership is at the handle level
- Administrators defined by handles
- Administrator handles contain keys
- All admin transactions validated via challenge/response from server to client
- Allows distributed administration

Metadata Collection and DOI Registration

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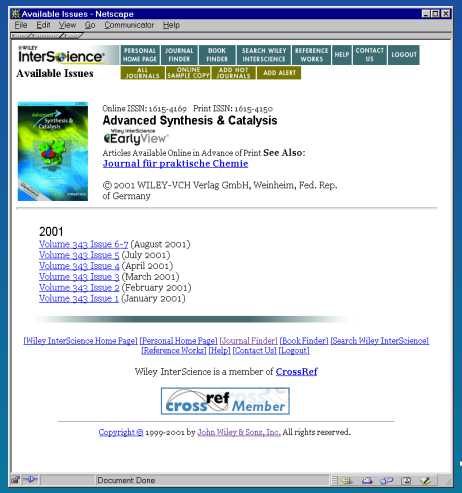
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Handle Data and Metadata

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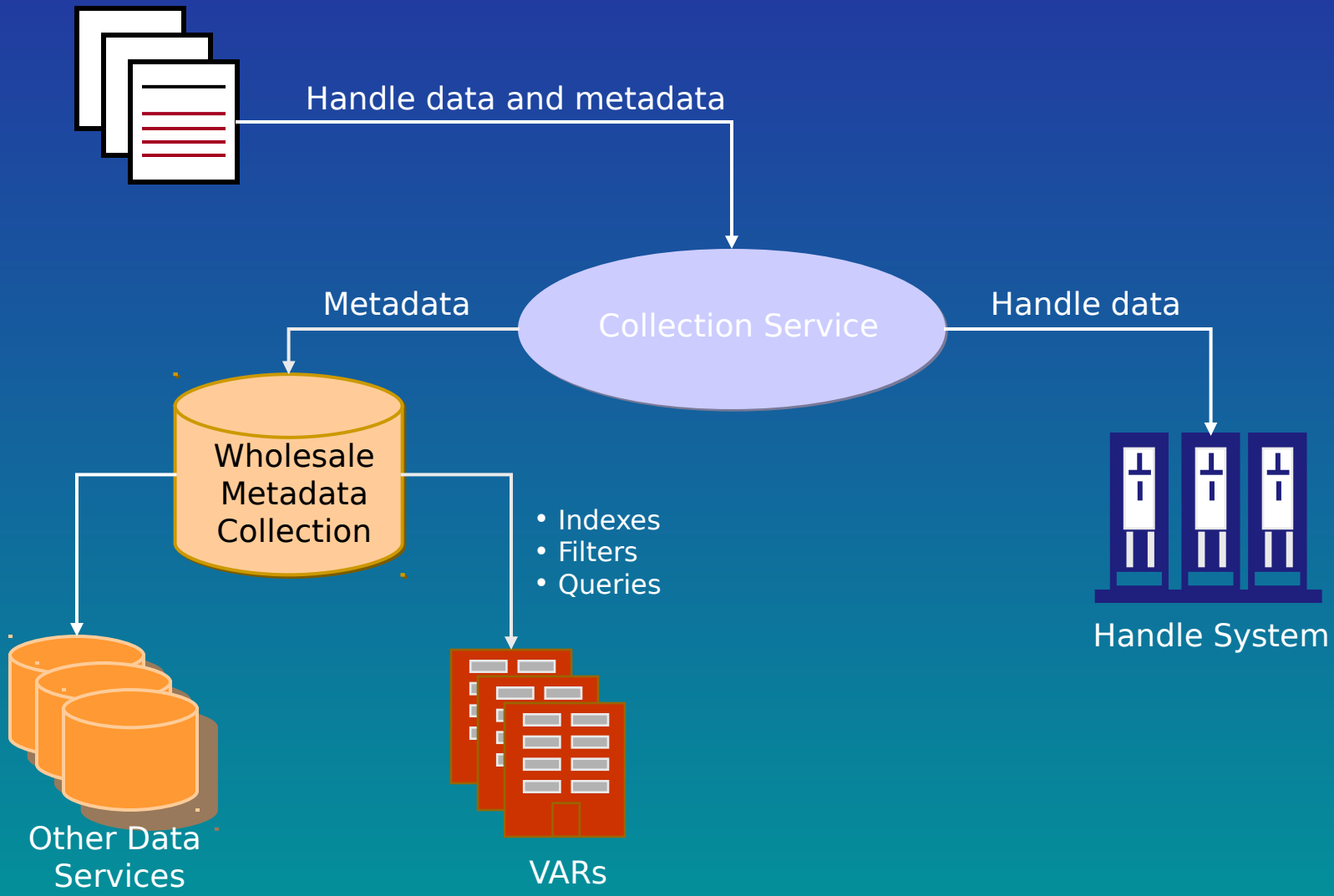
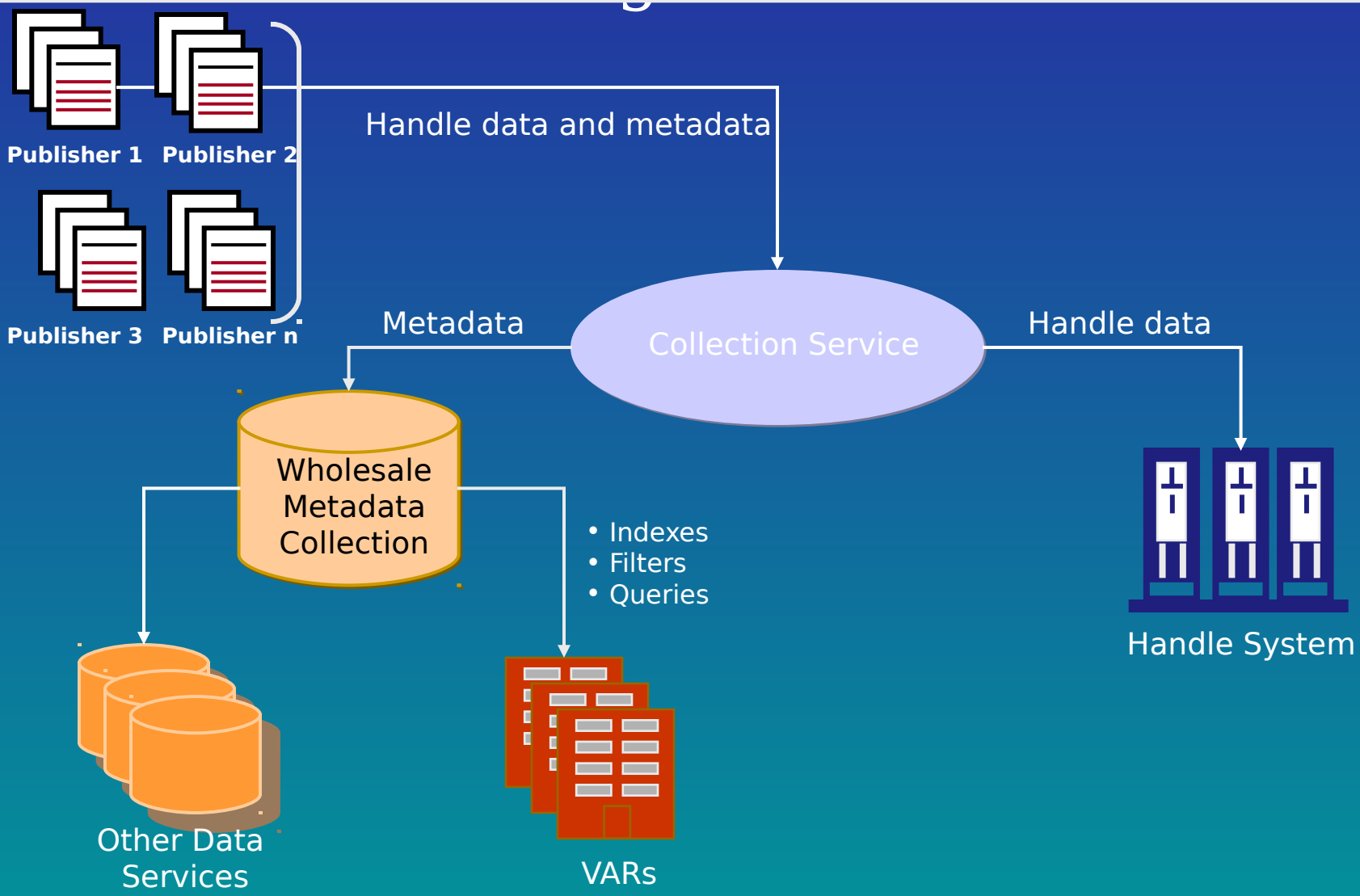
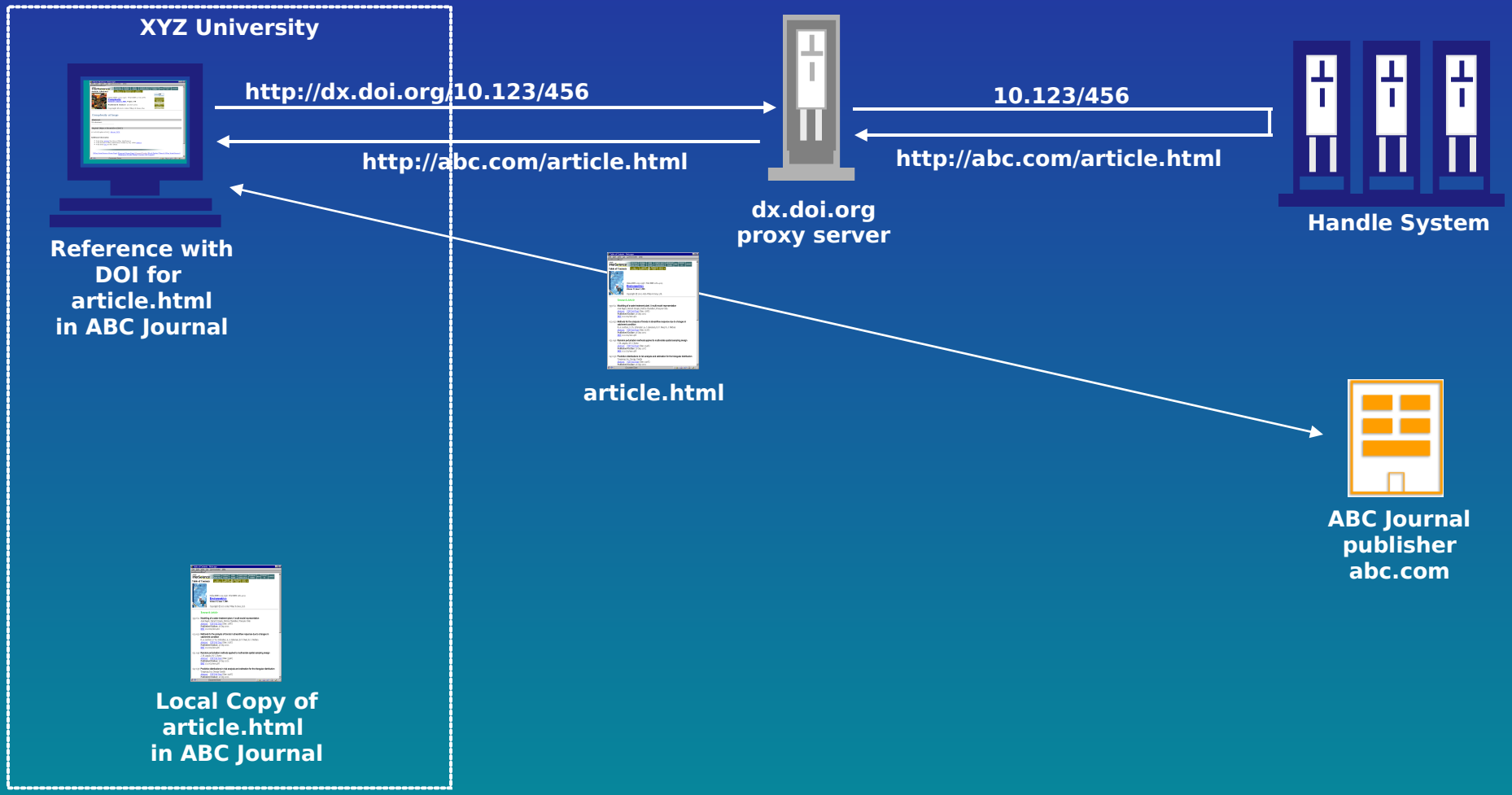
Metadata Collection and DOI Registration



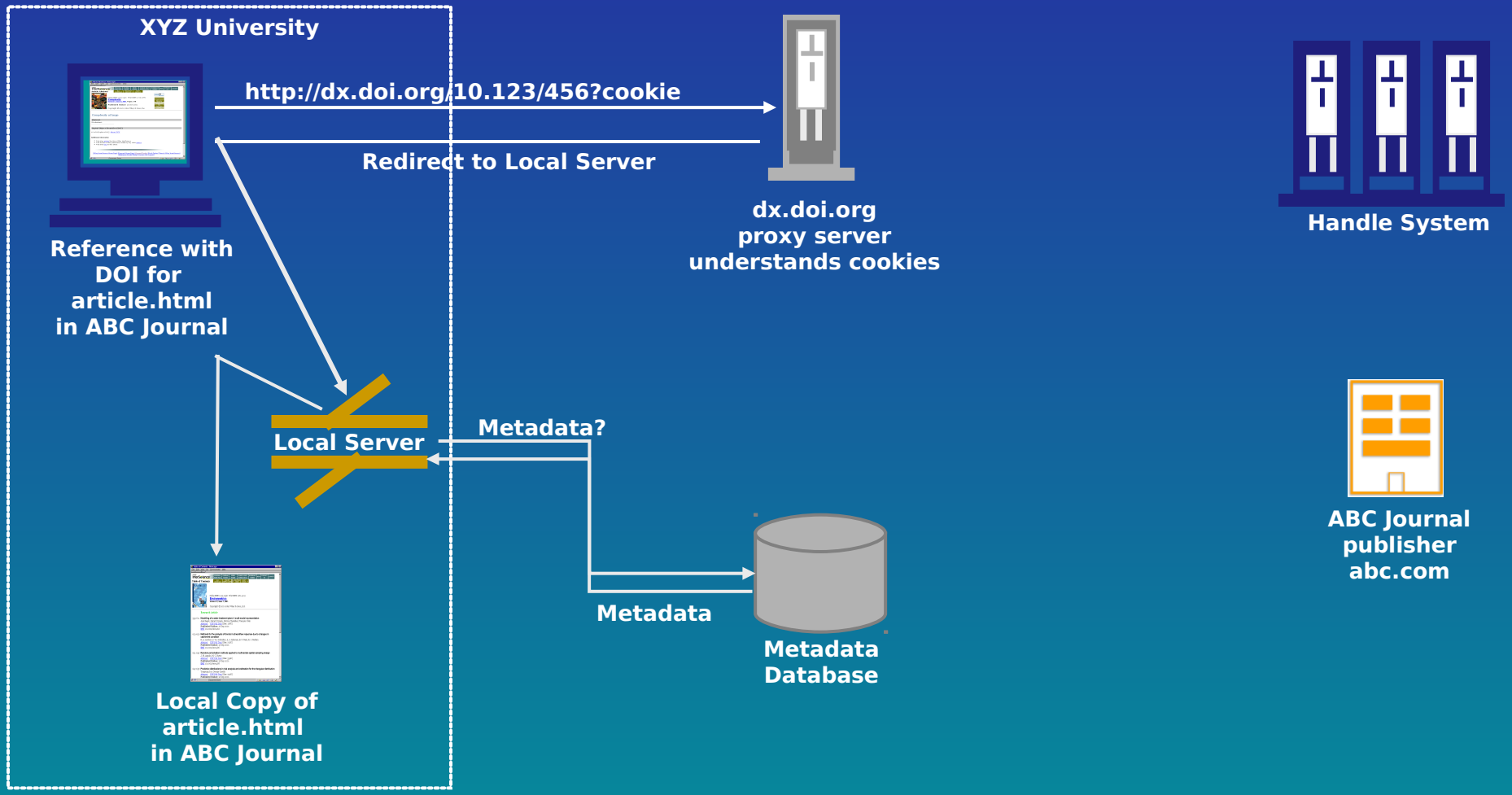
Metadata Collection and DOI Registration



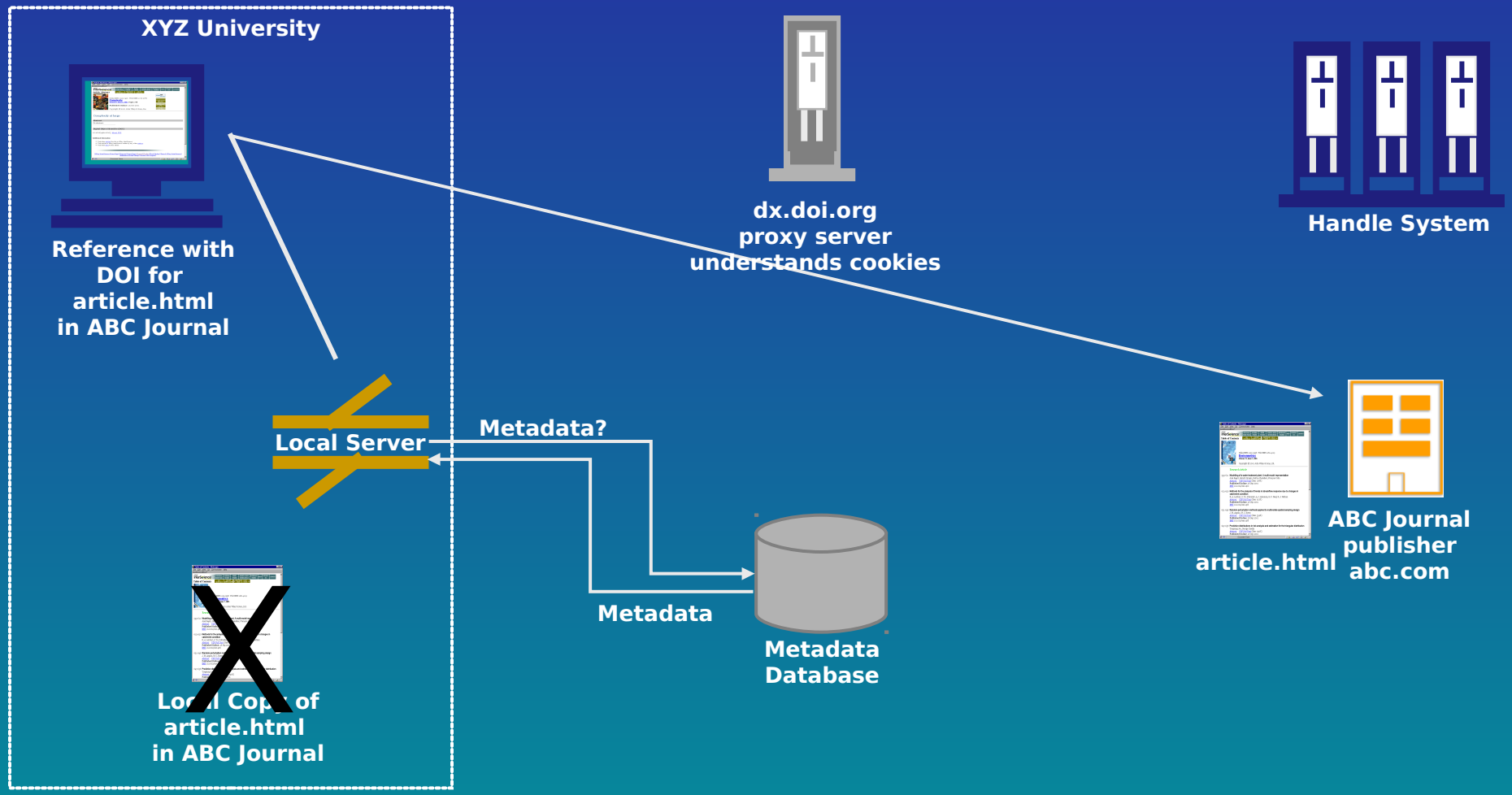
Appropriate Copy Problem



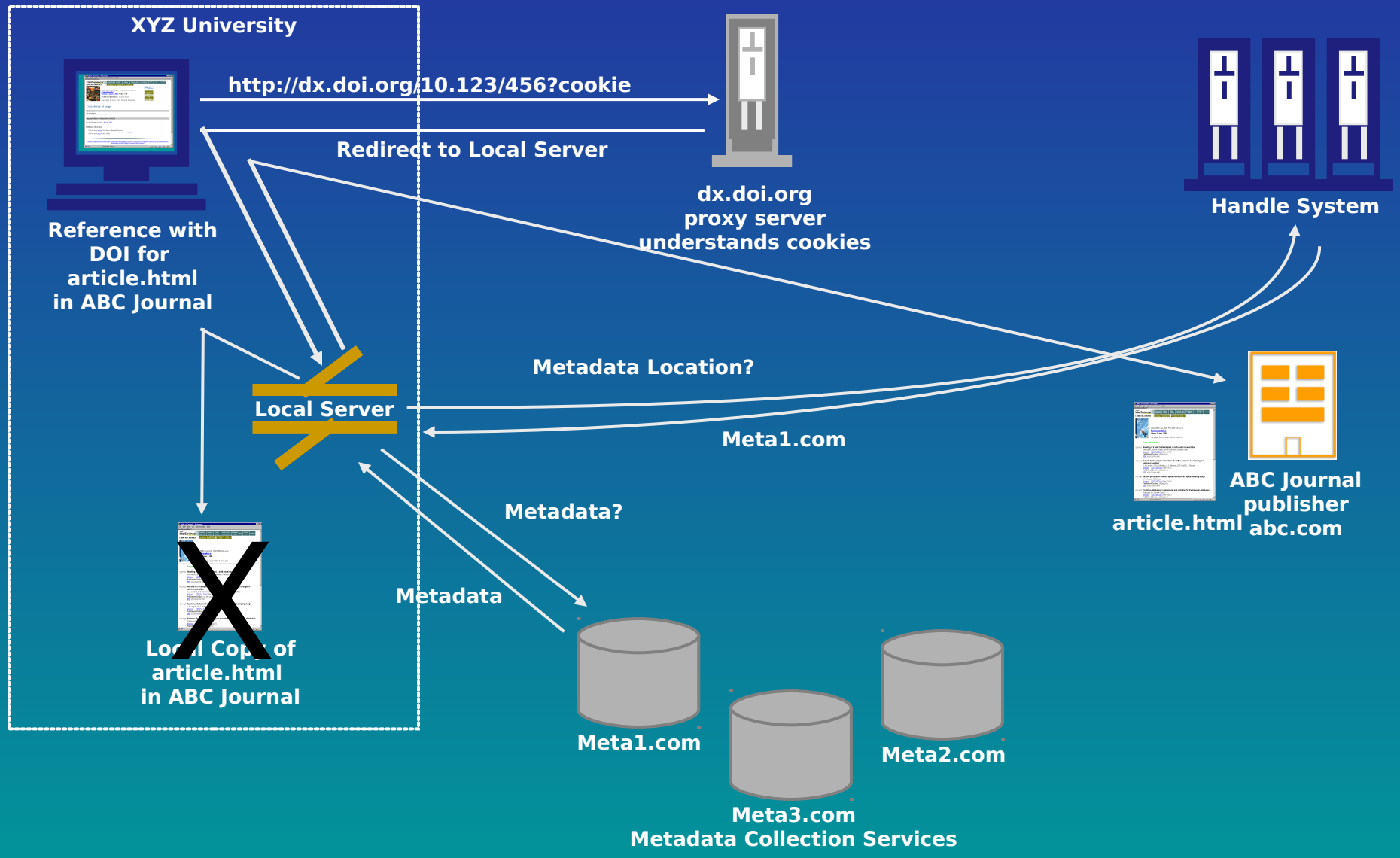
Appropriate Copy Problem: solved



Appropriate Copy Problem solved w/o local copy



Appropriate Copy Problem extensible solution



Other Types of Handle Projects

- CNNIC (China Internet Network Information Center)
  - Resolve Domain Names using HS with DNS interface
  - Add functions - security, I18N, distributed admin
  - Add specific services, e.g., ENUM (phone # to IP)
- Authentication of mobile agents (Knowbots)
  - HS as trusted Public Key Infrastructure
  - Agents signed by dispatching entity and subsequent ‘stops’
  - Public keys kept in handle records
- GRID identifier system
  - Transactions
  - Short-lived resources
  - Write-many, read-few